PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Gas Turbine Power Plants

We, WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, of 40, Wall Street, New York 5, State of New York, United States of America, a Corporation organised and existing under the Laws of the State of Delaware, in said United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to gas turbine power plants, particularly to an aviation turbojet or turboprop engine structure, and has for an object the provision of improved apparatus of the class described.

Another object of the invention is the provision of an improved rotor aggregate and bearing structure for a gas turbine power plant facilitating the manufacture, assembly and maintenance of such plant.

With the above objects in view, the improved gas turbine power plant, according to this invention, comprises a casing structure, a rotor aggregate including a compressor rotor portion carried by a shaft, a turbine rotor portion and a tubular intermediate shaft portion connected at its upstream end to the downstream end of the compressor rotor shaft and at its downstream end to the upstream end of the turbine rotor portion, said tubular intermediate shaft portion being of greater diameter than the compressor rotor shaft and constituting the sole driving connection between the said turbine and compressor rotor portions, and a two-bearing journal system carried by the casing structure for the rotor aggregate, one of said bearings being a combined thrust and journal bearing located adjacent to and supporting the upstream end of the compressor rotor shaft, and the second bearing being located adjacent to and supporting the downstream end of the turbine rotor portion.

According to a preferred embodiment, the gas turbine power plant comprises a substantially cylindrical casing structure having an axial passage extending therethrough, fuel combustion apparatus mounted in an intermediate annulus in the axial passage of said casing structure, a rear bearing supported in the rearward portion of said casing structure and adapted to be subjected to a radial load, a front bearing supported in the forward portion of said casing structure and adapted to receive both thrust and radial loads, and a turbo-compressor rotor aggregate mounted coaxially in said casing structure between said bearings and entirely supported thereby, said rotor aggregate including a compressor rotor portion disposed closely adjacent said front bearing and comprising a plurality of compressor discs having an axial spindle journalled on said front bearing, said discs being joined together at annuli coaxial with said axial spindle and terminating at its downstream end in an annular flange of substantially the same diameter of said annuli, a turbine rotor portion disposed closely in advance of said rear bearing and comprising a turbine disc unit carrying at its upstream end an annular flange of substantially the same diameter as said annuli and having a rearwardly extending axial spindle journalled in said rear bearing and a tubular intermediate shaft portion having a diameter substantially equal to that of said jointure annuli of said compressor discs and interposed between and joining said annular flanges of said compresor and turbine rotor portions.

In order that the invention may be more clearly understood and readily carried into effect, reference will now be made to the accompanying drawings, in which:—

Fig. 1 is a schematic elevational view, partly in section, of an aviation gas turbine power plant constructed in accordance with the invention;

Fig. 2 is a fragmentary, enlarged detail sectional view of the forward bearing asso-

ciated with the compressor of the apparatus shown in Fig. 1; and

Fig. 3 is a fragmentary, enlarged detail sectional view of the rear bearing associated with the turbine.

The present invention can be employed to advantage with either a turbojet engine or a turboprop engine. The gas turbine engine illustrated in Fig. 1 is of the turbojet type, and comprises a cylindrical outer casing structure 11 having mounted therein a sectional core structure 12, forming an annular fluid flow passageway 13 which extends axially through the power plant from an annular air inlet 14 to a rearwardly disposed discharge nozzle 15. The elements of the power plant are arranged in alignment with the axis thereof, thus minimizing the frontal area and drag incident to forward motion of the aircraft (not shown) which will carry the turbojet with the inlet 14 pointed in the direction of flight. These elements include a cowl or fairing 17 housing auxiliary control and starting equipment (not shown), an axial-flow compressor 18 having a rotor assembly 19, annular combustion apparatus 20, and a turbine 21 having a rotor 22 which is operatively connected to the compressor rotor through the medium of a tubular shaft 23 disposed interiorly of the combustion apparatus. Associated with the combustion apparatus 20 are a plurality of annular fuel manifolds and nozzles 24, which are supported on suitable radial struts, such as the strut 25 having an interior passage through which the usual fuel supply lines or conduits extend.

According to the invention as hereinafter more fully described, the compressor rotor assembly 19, shaft 23 and turbine rotor 22 constitute a spindle aggregate that is journalled on two bearings, consisting of a forwardly disposed thrust bearing 27 supported by means of radial struts 28 adjacent the front end of the compressor, and a rear bearing 30 supported by radial struts 31 disposed downstream with respect to the turbine.

The general principles of operation of such a gas turbine engine are well known. Air entering the inlet 14 is compressed by the compresor 18 and conducted through the passage 13 to the combustion apparatus 20, wherein fuel supplied by way of the manifolds and nozzles 24 is burned to create the necessary motive fluid which is expanded through the turbine 21 and finally discharged through the nozzle 15, establishing a propulsive thrust.

The compressor rotor assembly 19 comprises a plurality of bladed discs such as discs 33 and 34 shown in Fig. 2, which are provided with annular groups of interlocking teeth 35 disposed concentrically of the rotor axis. The discs are held in assembled relation between front and rear head members 37 and 38 (see Fig. 1) secured to an axial rod member 39 and sleeve 40 by suitably threaded connections. The head member 37 has a forwardly extending bearing portion 42, on which are mounted the inner races of ball bearing assemblies 43, forming elements of the forward thrust bearing generally indicated by the reference character 27. The outer races of the bearing assemblies 43 are of the spherically mounted type, as best shown in Fig. 2.

The enlarged tubular shaft 23, as shown in Figs. 1 and 3, has a diameter sufficient to withstand bending stresses on the rotor aggregate during rotation in the front and rear bearings 27 and 30, and in the present embodiment of the invention is of a diameter substantially equal to that of the annulus of the interlocked teeth 35 of the compressor discs. The tubular shaft 23 may be formed by joining a plurality of cylindrical sections 23*a* and 23*b* having annular flanges 23*c* secured together by bolts or other suitable means (not shown). A forwardly disposed annular flange 46 formed on the section 23*a* is similarly secured to a complementary flange carried by the head member 38 of the compressor rotor assembly. A rearwardly disposed annular flange 47 is likewise provided on the section 23*b* of the shaft for engagement with a flange 48 formed on one of the discs of the turbine rotor 22. As shown in Fig. 3, the flanges 47 and 48 may be secured by bolts 49. The rear bearing assembly 30 includes a bearing member 50, having a flange 51 that is secured by bolts 52 to the turbine rotor 22, and terminating in a short shaft portion 53 supported in a spherically mounted roller bearing and race assembly 54.

It will now be seen that with the power plant constructed in accordance with the invention, a saving in weight is effected, while manufacturing, assembly and maintenance are facilitated, by the distribution of the entire load of the improved rotor aggregate between the forward bearing 27 and the rear bearing 30, which are both spherically mounted to ensure proper alignment. Rigidity in the rotor aggregate is achieved by use of the relatively large hollow shaft 23 between the compressor and turbine. Because of the resultant elimination of the conventional No. 2 bearing ordinarily disposed at the discharge end of the compressor, the struts 25 are released from the function of carrying oil lines and thermocouple leads, while the fuel mani-

folds and adjacent elements are relieved from structural loading.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A gas turbine power plant comprising a casing structure, a rotor aggregate including a compressor rotor portion carried by a shaft, a turbine rotor portion and a tubular intermediate shaft portion connected at its upstream end to the downstream end of the compressor rotor shaft and at its downstream end to the upstream end of the turbine rotor portion, said tubular intermediate shaft portion being of greater diameter than the compressor rotor shaft and constituting the sole driving connection between the said turbine and compressor rotor portions, and a two-bearing journal system carried by the casing structure for the rotor aggregate, one of said bearings being a combined thrust and journal bearing located adjacent to and supporting the upstream end of the compressor rotor shaft, and the second bearing being located adjacent to and supporting the downstream end of the turbine rotor portion.

2. A gas turbine power plant comprising a substantially cylindrical casing structure having an axial passage extending therethrough, fuel combustion apparatus mounted in an intermediate annulus in the axial passage of said casing structure, a rear bearing supported in the rearward portion of said casing structure and adapted to be subjected to a radial load, a front bearing supported in the forward portion of said casing structure and adapted to receive both thrust and radial loads, and a turbo-compressor rotor aggregate mounted coaxially in said casing structure between said bearings and entirely supported thereby, said rotor aggregate including a compressor rotor portion disposed closely adjacent said front bearing and comprising a plurality of compressor discs having an axial spindle journalled on said front bearing, said discs being joined together at annuli coaxial with said axial spindle and terminating at its downstream end in an annular flange of substantially the same diameter of said annuli, a turbine rotor portion disposed closely in advance of said rear bearing and comprising a turbine disc unit carrying at its upstream end an annular flange of substantially the same diameter as said annuli and having a rearwardly extending axial spindle journalled in said rear bearing and a tubular intermediate shaft portion having a diameter substantially equal to that of said jointure annuli of said compressor discs and interposed between and joining said annular flanges of said compressor and turbine rotor portions.

3. A gas turbine power plant as claimed in Claim 1 or 2, wherein both of said bearings are spherically mounted to assure positive alignment thereof with respect to the axis of said rotor aggregate.

4. A gas turbine power plant substantially as hereinbefore described with reference to the accompanying drawings.

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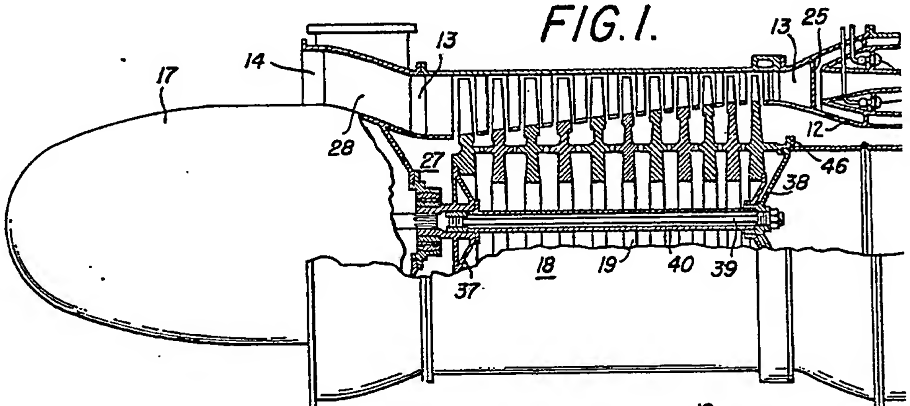
FIG. 1.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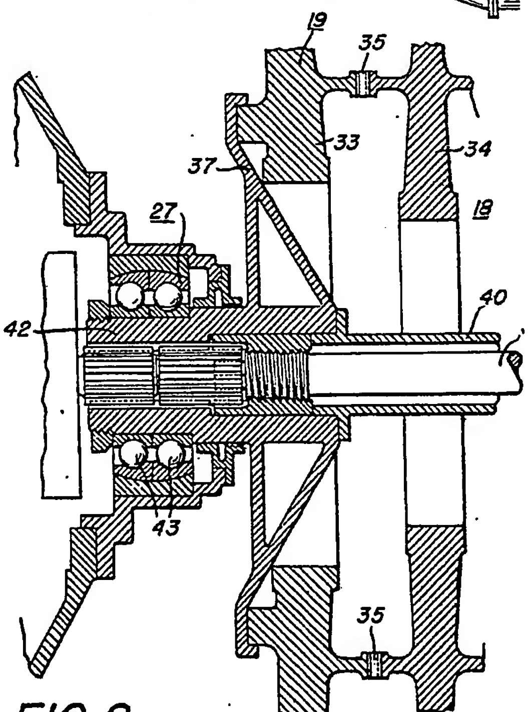
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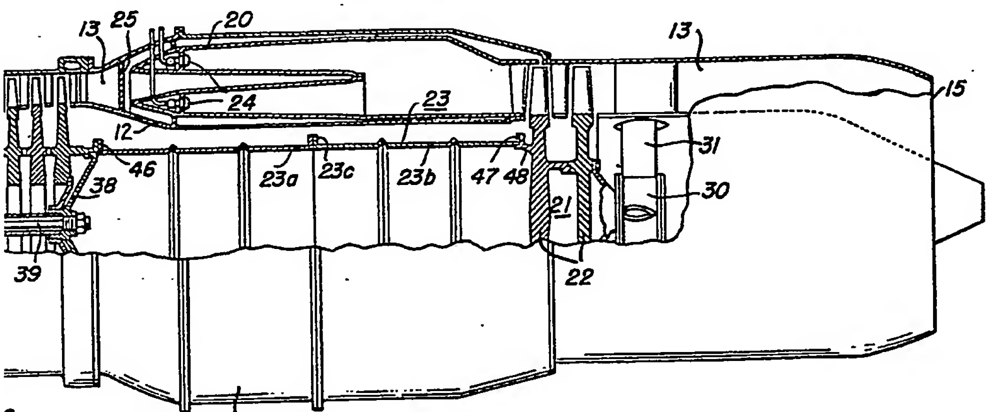
FIG. 2.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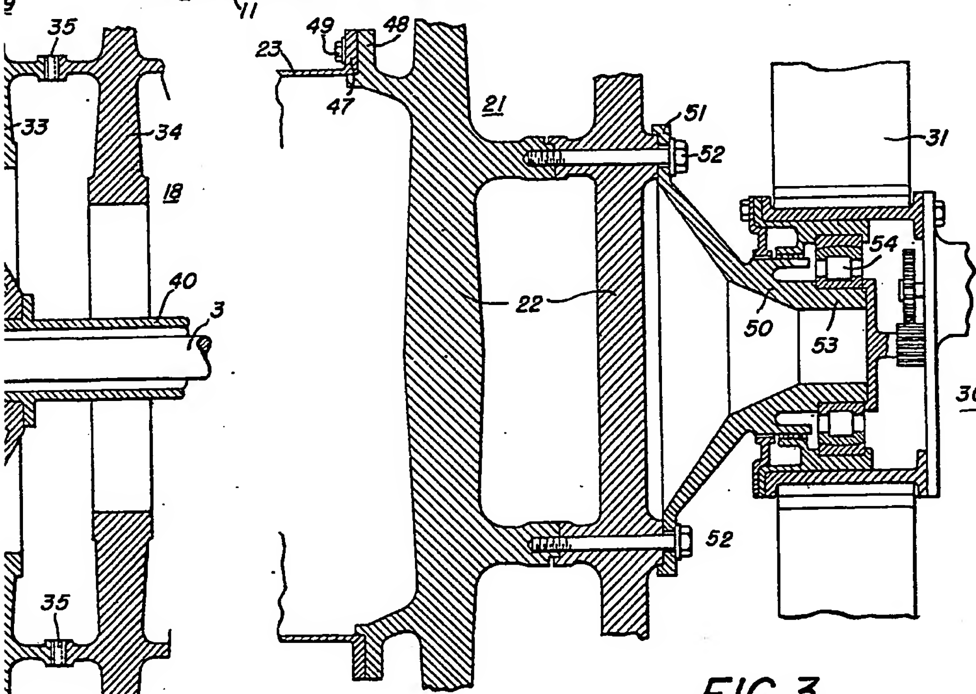
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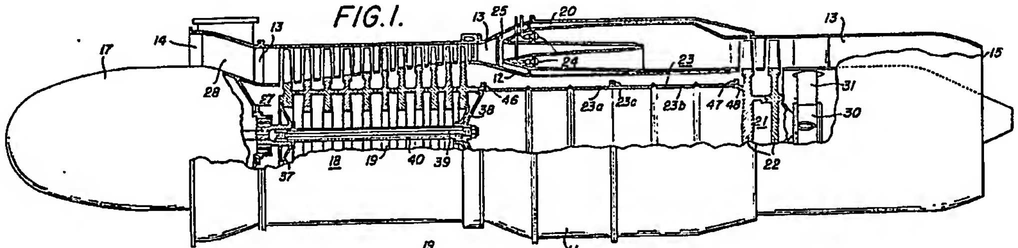
FIG.3.

FIG. 1.



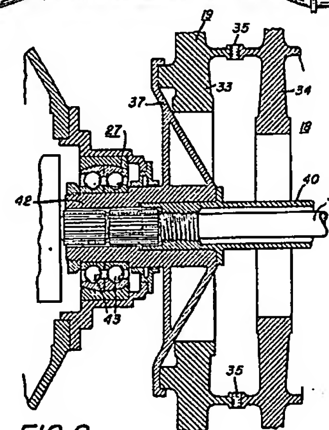


FIG. 2.

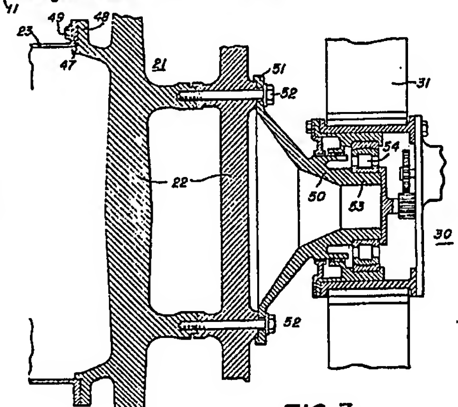


FIG. 3.